

# Pre-AP Geometry 11-4 Study Guide Spheres (pp 766-773)

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## Attendance Problems

1. Find the radius of circle  $M$  if the diameter is 25 cm.
2. Find the the circumference of circle  $X$  if the radius is 42.5 in.
3. Find the area of circle  $T$  if the diameter is 26 ft.
4. Find the circumference of circle  $N$  if the area is  $625\pi \text{ cm}^2$ .

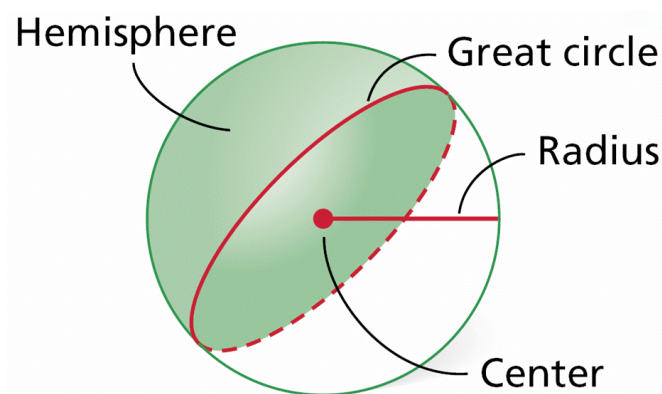
- I can learn and apply the formula for the volume of a sphere.
- I can learn and apply the formula for the surface area of a sphere.

**Question:** What do you call the force on the surface of a balloon?

**Answer:** Sphere pressure.

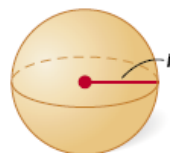
**Common Core: CC.9-12.G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

A **sphere** is the locus of points in space that are a fixed distance from a given point called the **center of a sphere**. A **radius of a sphere** connects the center of the sphere to any point on the sphere. A **hemisphere** is half of a sphere. A **great circle** divides a sphere into two hemispheres



### Volume of a Sphere

The volume of a sphere with radius  $r$  is  $V = \frac{4}{3}\pi r^3$ .



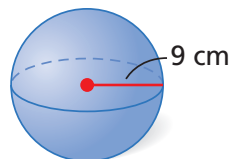
"You can't win by being more average than average."—Writer, Seth Godin

**1 Finding Volumes of Spheres**Find each measurement. Give your answer in terms of  $\pi$ .**A** the volume of the sphere

$$V = \frac{4}{3}\pi r^3$$

$$V = \frac{4}{3}\pi(9)^3 \quad \text{Substitute 9 for } r.$$

$$= 972\pi \text{ cm}^3 \quad \text{Simplify.}$$

Find each measurement. Give your answer in terms of  $\pi$ .**B** the diameter of a sphere with volume  $972\pi \text{ in}^3$ 

$$972\pi = \frac{4}{3}\pi r^3 \quad \text{Substitute } 972\pi \text{ for } V.$$

$$729 = r^3 \quad \text{Divide both sides by } \frac{4}{3}\pi.$$

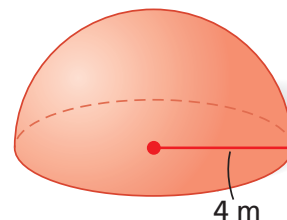
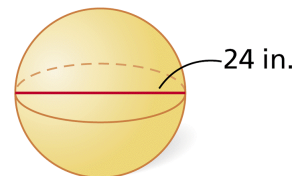
$$r = 9 \quad \text{Take the cube root of both sides.}$$

$$d = 18 \text{ in.} \quad d = 2r$$

**C** the volume of the hemisphere

$$V = \frac{2}{3}\pi r^3 \quad \text{Volume of a hemisphere}$$

$$= \frac{2}{3}\pi(4)^3 = \frac{128\pi}{3} \text{ m}^3 \quad \text{Substitute 4 for } r.$$

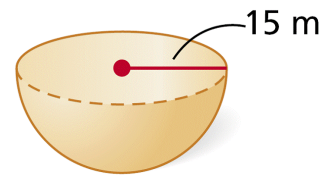
**Example 1.** Find each measurement. Give your answer in terms of  $\pi$ .**A.** The volume of the sphere.

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**B.** The diameter of a sphere with volume  $36,000\pi \text{ cm}^3$ .

**C.** The volume of the hemisphere.



5. **Guided Practice.** Find the radius of a sphere with volume  $2304\pi \text{ ft}^3$ .

## 2 **Biology Application**

Giant squid need large eyes to see their prey in low light. The eyeball of a giant squid is approximately a sphere with a diameter of 25 cm, which is bigger than a soccer ball. A human eyeball is approximately a sphere with a diameter of 2.5 cm. How many times as great is the volume of a giant squid eyeball as the volume of a human eyeball?

human eyeball:

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(1.25)^3 \approx 8.18 \text{ cm}^3 \end{aligned}$$

giant squid eyeball:

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(12.5)^3 \approx 8181.23 \text{ cm}^3 \end{aligned}$$

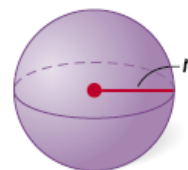
A giant squid eyeball is about 1000 times as great in volume as a human eyeball.

**Example 2.** A sporting goods store sells exercise balls in two sizes, standard (22-in. diameter) and jumbo (34-in. diameter). How many times as great is the volume of a jumbo ball as the volume of a standard ball?

**6. Guided Practice.** A hummingbird eyeball has a diameter of approximately 0.6 cm. A human eyeball is approximated by a sphere with a diameter of 2.5 cm. How many times as great is the volume of a human eyeball as the volume of a hummingbird eyeball?

### Surface Area of a Sphere

The surface area of a sphere with radius  $r$  is  $S = 4\pi r^2$ .



**3 Finding Surface Area of Spheres**Find each measurement. Give your answers in terms of  $\pi$ .

- A**
- the surface area of a sphere with diameter 10 ft

$$S = 4\pi r^2$$

$$S = 4\pi(5)^2 = 200\pi \text{ ft}^2 \quad \text{Substitute 5 for } r.$$

- B**
- the volume of a sphere with surface area
- $144\pi \text{ m}^2$

$$S = 4\pi r^2$$

$$144\pi = 4\pi r^2 \quad \text{Substitute } 144\pi \text{ for } S.$$

$$6 = r \quad \text{Solve for } r.$$

$$V = \frac{4}{3}\pi r^3$$

$$= \frac{4}{3}\pi(6)^3 = 288\pi \text{ m}^3 \quad \text{Substitute 6 for } r.$$

The volume of the sphere is  $288\pi \text{ m}^3$ .

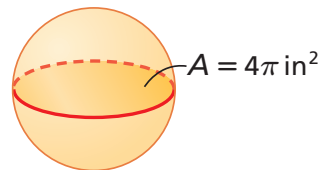
- C**
- the surface area of a sphere with a great circle that has an area of
- $4\pi \text{ in}^2$

$$\pi r^2 = 4\pi \quad \text{Substitute } 4\pi \text{ for } A \text{ in the formula for the area of a circle.}$$

$$r = 2 \quad \text{Solve for } r.$$

$$S = 4\pi r^2$$

$$= 4\pi(2)^2 = 16\pi \text{ in}^2 \quad \text{Substitute 2 for } r \text{ in the surface area formula.}$$

**Example 3.** Find each measurement. Give your answer in terms of  $\pi$ .

- A.**
- The surface area of a sphere with diameter 76 cm.

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**B.** Find the volume of a sphere with surface area  $324\pi$  in<sup>2</sup>.

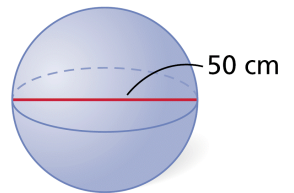


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C. The surface area of a sphere with a great circle that has an area of  $49\pi$  mi<sup>2</sup>.

8. **Guided Practice.** Find the surface area of the sphere.



**4 Exploring Effects of Changing Dimensions**

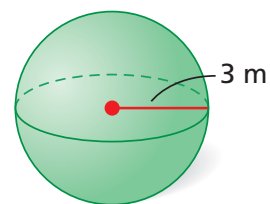
The radius of the sphere is tripled. Describe the effect on the volume.

original dimensions:

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(3)^3 \\ &= 36\pi \text{ m}^3 \end{aligned}$$

radius tripled:

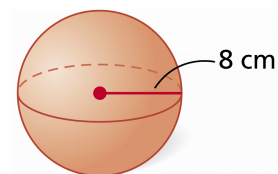
$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(9)^3 \\ &= 972\pi \text{ m}^3 \end{aligned}$$



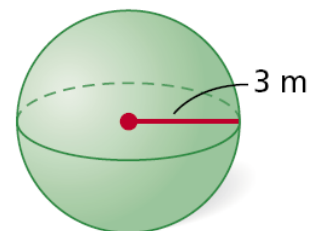
Notice that  $972\pi = 27(36\pi)$ . If the radius is tripled, the volume is multiplied by 27.

**Example 4.** The radius of the sphere is multiplied by  $\frac{3}{4}$ .

Describe the effect on the volume.



**9. Guided Practice.** The radius of the sphere is divided by 3. Describe the effect on the surface area.



## 5

**Finding Surface Areas and Volumes of Composite Figures**

Find the surface area and volume of the composite figure.  
Give your answers in terms of  $\pi$ .

**Step 1** Find the surface area of the composite figure.

The surface area of the composite figure is the sum of the surface area of the hemisphere and the lateral area of the cone.

$$S(\text{hemisphere}) = \frac{1}{2}(4\pi r^2) = 2\pi(7)^2 = 98\pi \text{ cm}^2$$

$$L(\text{cone}) = \pi r \ell = \pi(7)(25) = 175\pi \text{ cm}^2$$

The surface area of the composite figure is  $98\pi + 175\pi = 273\pi \text{ cm}^2$ .

**Step 2** Find the volume of the composite figure.

First find the height of the cone.

$$h = \sqrt{25^2 - 7^2} \quad \text{Pythagorean Theorem}$$

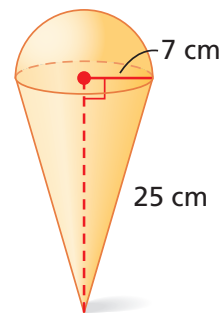
$$= \sqrt{576} = 24 \text{ cm} \quad \text{Simplify.}$$

The volume of the composite figure is the sum of the volume of the hemisphere and the volume of the cone.

$$V(\text{hemisphere}) = \frac{1}{2}\left(\frac{4}{3}\pi r^3\right) = \frac{2}{3}\pi(7)^3 = \frac{686\pi}{3} \text{ cm}^3$$

$$V(\text{cone}) = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(7)^2(24) = 392\pi \text{ cm}^3$$

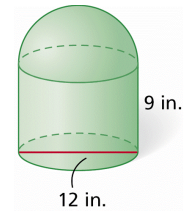
The volume of the composite figure is  $\frac{686\pi}{3} + 392\pi = \frac{1862\pi}{3} \text{ cm}^3$ .



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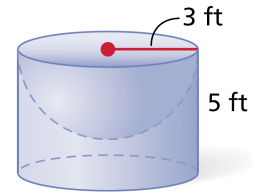
**Example 5.** Find the surface area and volume of the composite figure. Give your answer in terms of  $\pi$ .



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**9. Guided Practice.** Find the surface area and volume of the composite figure.



### **11-4 Spheres:**

- (p 771) 13, 15, 16, 17, 19-23, 30, 36, 39, 40, 41.
- 11A Ready to Go On Pretest & posttests.

